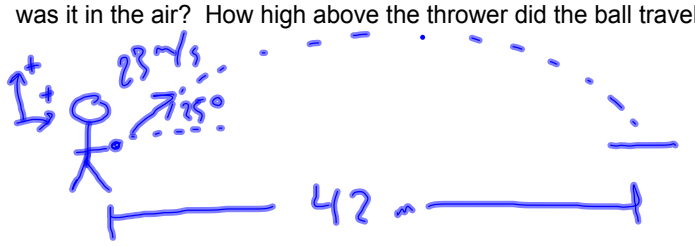
Quarter Exam Notes and Practice Problems 4th Block 10.17.11

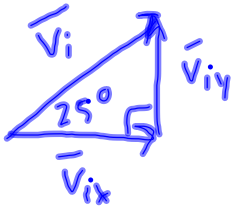
A baseball is thrown at an angle of 25 degrees above the ground at a speed of 23.0 m/s. If the ball was caught 42.0 m from the thrower at the same height it was thrown, how long was it in the air? How high above the thrower did the ball travel?



$\Delta x = 42\ m$ $\quad v_i = 23\ m/s$ $\quad a_y = a_g = -9.8\ m/s^2$

$\Delta y = ?$ $\quad v_{ix} = ?$ $\quad a_x = 0\ m/s^2$

$t = ?$ $\quad v_{iy} = ?$



$v_{ix} = v_i \cos(25°) = 20.8\ m/s$

$v_{iy} = v_i \sin(25°) = 9.72\ m/s$

a) $\Delta x = v_{ix} t + \frac{1}{2} a_x t^2$ ~~$= 0$~~

$t = \frac{\Delta x}{v_{ix}} = \frac{42\ m}{20.8\ m/s} = 2.02\ s$

b) at $t = 1.01\ s$, at its highest point

$\Delta y = v_{iy} t + \frac{1}{2} a_g t^2$

$= (9.72\ m/s)(1.01\ s) + \frac{1}{2}(-9.8\ m/s^2)(1.01\ s)^2$

$= 4.82\ m$

A 2.00 kg cat is in a 97.00 kg elevator. What force on the elevator cable would be needed to raise the cat/elevator pair upwards with an acceleration of 2.00 m/s/s upwards?

$m = m_c + m_e$

$= 99\ kg$

$$\sum \bar{F}_y = m\bar{a}_y$$

$$F_T - F_g = ma_y \qquad F_g = ma_g$$

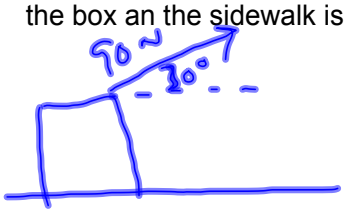
$$F_T = m(a_g + a_y)$$

$$= (99\ kg)(9.8\ m/s^2 + 2\ m/s^2)$$

$$= 1168\ N$$

Variable	Units
Δx	m
t	s
Δy	m
a	m/s^2
v	m/s
μ	none
F	$N = kg \cdot m/s^2$
p	$kg \cdot m/s$
m	kg
J	$kg \cdot m/s$
θ	degrees

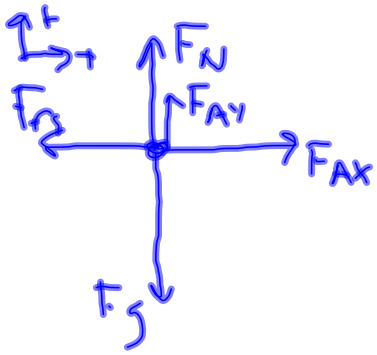
A student attaches a rope to a 20.0 kg box of books. He pulls with a force of 90.0 N at an angle of 30.0 degrees with the horizontal. The coefficient of kinetic friction between the box an the sidewalk is 0.500. Find the acceleration of the box.



$F_A = 90\ N$

$F_{Ax} = F_A \cos(30°) = 77.9\ N$

$F_{Ay} = F_A \sin(30°) = 45\ N$



$\sum \bar{F}_x = m\bar{a}_x$

$a_x = \dfrac{\sum F_x}{m}$

$= \dfrac{F_{Ax} - F_{fk}}{m}$

$= \dfrac{77.9\ N - 75.5\ N}{20\ kg}$

$= 0.122\ m/s^2$

$F_{fk} = \mu_k F_N$

$= (.5)(151\ N)$

$= 75.5\ N$

$\sum \bar{F}_y = 0$

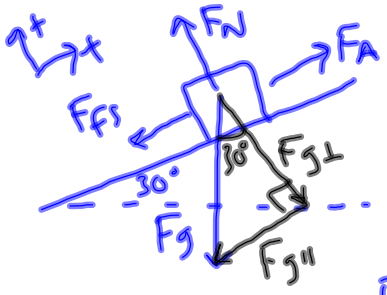
$F_N + F_{Ay} - F_g = 0$

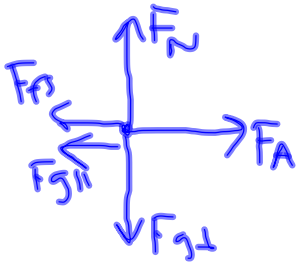
$F_N = F_g - F_{Ay}$

$= ma_g - F_{Ay}$

$= 151\ N$

A block is at rest on a ramp that is inclined at 30 degrees above the horizontal. The mass of the block is 85 kg, and the applied force (direction is parallel to the ramp upwards) that just causes the block to move is 600 N. What is the coefficient of friction between the block and the incline?





$F_{g\parallel} = F_g \sin(30°) = 417\ N$

$F_{g\perp} = F_g \cos(30°) = 721\ N$

$F_{fs} = \mu_s F_N$

$\mu_s = \frac{F_{fs}}{F_N}$

$= \frac{184\ N}{721\ N}$

$= .254$

$\Sigma \vec{F}_{\parallel} = 0$

$F_A - F_{g\parallel} - F_{fs} = 0$

$F_{fs} = F_A - F_{g\parallel}$

$= 184\ N$

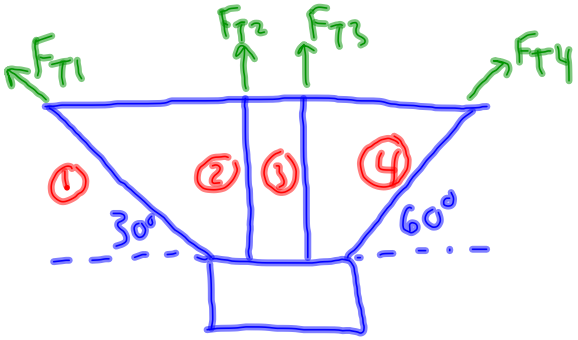
$\Sigma \vec{F}_{\perp} = 0$

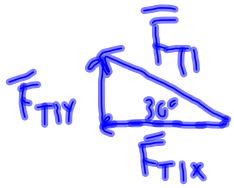
$F_N - F_{g\perp} = 0$

$F_N = F_{g\perp}$

$= 721\ N$

A 200 kg block is suspended by four solid rods. The far left rod is at an angle of 30 degrees above the horizontal at the block, the middle-left and middle-right rods are vertical, and the far right rod is at 60 degrees above the horizontal at the block. Find the tension in each rod.



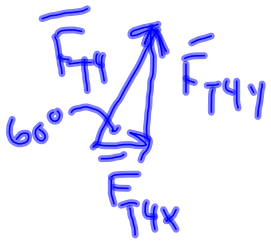
1) 

$$\sin(30°) = \frac{F_{T1Y}}{F_{T1}}$$

$$F_{T1} = \frac{F_{T1Y}}{\sin(30°)} = 980\ N$$

2) $$F_{T2} = \frac{F_g}{4} = \frac{(200\ kg)(9.8\ m/s^2)}{4} = 490\ N$$

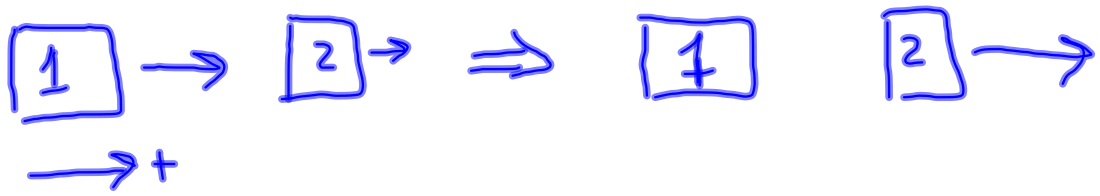
3) $$F_{T3} = F_{T2} = 490\ N$$

4) 

$$\sin(60) = \frac{F_{T4Y}}{F_{T4}}$$

$$F_{T4} = \frac{F_{T4Y}}{\sin(60°)} = 566\ N$$

A 1000 kg car is traveling 20 m/s east and hits another car of mass 1500 kg traveling 12 m/s east. After they collide, the car of mass 1500 kg travels at 18 m/s. If the collision is elastic, find the velocity (magnitude and direction) of the 1000 kg car after the collision.



$$m_1\bar{v}_{1i} + m_2\bar{v}_{2i} = m_1\bar{v}_{1f} + m_2\bar{v}_{2f}$$

$$v_{1f} = \frac{1}{m_1}\left[m_1 v_{1i} + m_2 v_{2i} - m_2 v_{2f}\right]$$

$$= +11 \text{ m}$$